NASA's EDSN Aims to Overcome the Operational Challenges of CubeSat Constellations and Demonstrate an Economical Swarm of 8 CubeSats Useful for Space Science Investigations

Operators of a constellation of CubeSats have to confront a number of daunting challenges that can be cost prohibitive, or operationally prohibitive, to missions that could otherwise be enabled by a satellite constellation. Challenges including operations complexity, intersatellite communication, intersatellite navigation, and time sharing tasks between satellites are all complicated by operating with the usual CubeSat size, power, and budget constraints. EDSN pioneers innovative solutions to these problems as they are presented on the nano-scale satellite platform.

Traditionally, when operating a constellation of satellites the ground support required increases dramatically as constellation size increases. These difficulties apply to EDSN as well, but are partially mitigated through a novel on-satellite scheduler called PLEXIL, originally created for the NASA Ames LADEE mission. PLEXIL economically provides reliable, semi-autonomous, cooperative functions for distribution across the constellation. Additionally, advanced networking communications architecture enables the EDSN satellites to aggregate science and telemetry data. This allows downlink via a single satellite hub, eliminating the need to acquire each individual satellite and therefore greatly reducing the ground operations complexity and cost.

This paper will present the EDSN satellite swarm operations scheme and swarm activity coordination approach using novel on-orbit scheduling software necessary for dealing with operational complexity and solving the problems of economical CubeSat constellation operations.

[EDSN is a technology demonstration mission that will deploy 8 CubeSats in the Fall of 2013, simultaneously operating and coordinating all 8 satellites from a single ground station. The mission will demonstrate robust in-space networking (cross-linking between satellites and downlinking from a single satellite selected ad-hoc as the relay) while providing utility as a science platform by measuring temporally changing and geographically dispersed space weather data. EDSN's entire 8-satellite swarm costs under $400,000 in parts.]